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Long-term Regular Dental Attendance and Periodontal Disease in the 1998 Adult Dental Health Survey

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Abstract

Aim: To explore the association between long-term pattern of dental attendance and periodontal disease among British adults.

Methods: We used data from 3272 adults who participated in the 1998 Adult Dental Health Survey in the UK. Participants were classified into four trajectories (current, always, former and never regular attenders) based on their responses to three questions on lifetime dental attendance patterns. The numbers of teeth with pocket depth (PD)≥4mm and loss of attachment (LOA)≥4mm were the outcome measures. The association between dental attendance patterns and each periodontal measure was assessed in crude and adjusted models using negative binomial regression.

Results: Never and former regular attenders had more teeth with PD≥4mm (Rate Ratios with 95% Confidence Interval: 1.58 [1.28-1.95] and 1.34 [1.12-1.60], respectively) and LOA≥4mm (1.34 [1.04-1.72] and 1.37 [1.07-1.75], respectively) than always regular attenders, after adjustments for demographic (sex, age and country of residence) and socioeconomic factors (education and social class). However, no differences in periodontal measures were found between always and current regular attenders.

Conclusion: This analysis of national cross-sectional data shows that adults with different long-term patterns of dental attendance have different periodontal health status.

Clinical Relevance

Scientific rationale for study: Systematic reviews on the benefits of regular dental check-ups are inconclusive. Recent observational studies suggest that long-term regular attenders have better oral health than non-regular attenders. However, no study has explored the influence of long-term dental attendance on periodontal disease.

Principal findings: Never and former regular attenders, but not current regular attenders, had worse periodontal conditions than always regular attenders.

Practical implications: Regular dental visits for check-ups may provide dental professionals and their patients with opportunities for primary and secondary prevention of periodontal disease.

Introduction

Dental attendance may be motivated by preventive orientation resulting in regular dental check-ups or by pain and/or other complaints resulting in problem-oriented visits (Geyer and Micheelis, 2012, Gilbert et al., 2000). Regular dental attendance is a fundamental message in oral health promotion and prevention of oral diseases (Patel et al., 2010). Under ideal circumstances, a regular dental check-up involves early detection, appropriate treatment, routine monitoring and prevention of oral diseases along with the maintenance of a good relationship between dentist and patient and enhancing patient motivation and compliance by reinforcing professional preventive advice (Patel et al., 2010, Riley et al., 2013). However, three independent systematic reviews of randomised controlled trials have provided inconclusive evidence on the potential benefits or harmful effects of regular dental check-ups on oral health (Davenport et al., 2003, Patel et al., 2010, Riley et al., 2013).

Recent longitudinal studies suggest that long-term regular attenders have better oral health than non-regular attenders (Thomson et al., 2010, Crocombe et al., 2012, Brennan and Spencer, 2014, Astrom et al., 2014). In the Dunedin longitudinal study, long-term routine attenders (between ages 15 and 32 years) had better oral health related quality of life and less dental caries and tooth loss than non-routine attenders. The authors also found evidence of a cumulative effect, with longer regular attendance resulting in more favourable oral health by age 32 (Thomson et al., 2010). A subsequent analysis of the Dunedin study, including four data points (ages 15, 18, 26 and 32), identified three dental visiting trajectories; opportunists (non-routine attenders even when dental care was free of charge) had greater DMFS scores and more missing teeth due to caries than regular attenders whereas both decliners (those who changed from routine to non-routine attendance when free service was no longer available) and opportunists had higher Oral Health Impact Profile (OHIP-14) and lower self-rated oral health scores than regular attenders (Crocombe et al., 2012). In Sweden, adults who changed from non-routine to routine attendance (between ages 50 and 65 years) and those who remained routine attenders over the 15 year-period were less likely to have major tooth loss and oral impacts compared to long-term non-routine attenders. However, the proportion of adults with major tooth loss and oral impacts did not differ between those who changed from routine to non-routine attendance and non-routine attenders in adjusted models (Astrom et al., 2014). In Australia, Brennan and Spencer (2014) found that history of adverse dental events (episodes of relief of pain visits and episodes of dental extraction) between ages 13 and 30 years was associated with higher OHIP-14 scores at age 30 (a cumulative effect).

Evidence on the benefits of regular dental attendance on periodontal health is less convincing. Brown and Garcia (1994) found that regular visits for check-ups and preventive services were not a significant predictor of alveolar bone loss in men from Boston over a 6-year period. Beck et al. (1997) found that regular attendance was negatively associated with changes in pocket depth and attachment loss over 5 years in the Piedmont 65+ years study, although only at bivariate level. Broadbent et al. (2006) found that episodic attenders at age 26 years were more likely than routine attenders to have attachment loss≥4mm at age 32 years, although no adjusted results were presented. Despite renewed interest in the prevention of periodontal diseases (Tonetti et al., 2015b, Chapple et al., 2015, Tonetti et al., 2015a), no study has explored the influence of lifetime dental attendance on periodontal disease. To fill this gap in knowledge, a study was set to explore the association between long-term pattern of dental attendance and periodontal disease among British adults.

Methods

Study population

Data are from the 1998 Adult Dental Health Survey in the UK. This cross-sectional survey was based on a representative sample of adults, aged 16 years and over, living in the UK. Participants were selected by stratified random sampling. Briefly, 74% of all eligible households agreed to take part, and 92% of the 6764 adults in these households completed an interview. Of them, 6204 (92%) agreed to be interviewed on dental issues. A total of 5281 adults reported having one or more natural teeth during interviews. Of these dentate adults, 3817 (72%) had a dental examination and 3507 (66%) a periodontal examination. A full report with details on sampling strategy and response rates has been published elsewhere (Kelly et al., 2000). Data from 3272 dentate adults aged 16 years and over with complete information on relevant variables were analysed for this study.

Ethical approval for the survey was obtained from the North Thames Multi-Centre Research Ethics Committee and by the Local Research Ethics Committees in all the areas covered by the survey.

Data collection

Data were collected through face-to-face interviews and dental examinations. During interviews, participants' provided information on their demographic characteristics (age, sex and country of residence), socioeconomic factors (social class and education level) and long-term pattern of dental attendance. Education level was assessed as the highest level of

qualification received (no qualifications, below degree level, and degree level or above). Social class was measured on the basis of occupation of the household reference person, formerly the Registrar General's Social Class (RGSC). Participants with the same level of occupational skills were grouped using an ordinal scale with six categories: professional (IM), managerial and technical (II), skilled non-manual (IIINM), skilled manual (IIIM), partly skilled (IV) and unskilled (V) (Office of Population Censuses and Surveys, 1980). For the purposes of this study, classes I and II were combined (Highest group), as were classes IIINM and IIIM, and classes IV and V (Lowest group) (Bartley et al., 2004, Donaldson et al., 2008).

Participants' long-term pattern of dental attendance was derived from three questions. An introductory question asked participants whether they go to the dentist for a regular check-up, an occasional check-up, or only when they are having trouble with their teeth. Depending on their response to this initial question, participants were prompted with one of two possible follow-up questions. Those who said they go for a regular check-up were asked whether there has ever been a time in their life when they have not been for a regular check-up. Participants who said they go to the dentist for occasional check-up or only when they have problem with their teeth were asked if there have been a time in their life where they have been for regular check-ups. These questions allowed classification of participants into four distinctive trajectories: *always regular attenders* (reference category) were those who said they go to the dentist regularly for check and have always been regularly for check-ups; *current regular attenders* were those who said they go to the dentist regularly for check-ups but have not been always regular for check-ups; *former regular attenders* were those who said they go to the dentist occasionally or only when in trouble but used to go regularly for check-ups; and *never regular attenders* were those who said they go to the dentist occasionally or only when in trouble and have never been regularly for check-ups (Aldossary et al., 2015).

Dental examinations were conducted by 70 dentists with participants seated on a chair. Examiners were recruited from the Community Dental Services and they were well experienced in epidemiological work and familiar with the criteria used. Periodontal examination was carried out only if the medical history was clear. Participants' teeth were not brushed nor professionally cleaned prior to examination. Periodontal tissues were examined, under illumination by Daray light lamps, with plane mouth mirrors and CPI 'C' periodontal probe. All teeth, including third molars, were examined. Pocket depth (PD) and loss of attachment (LOA) were recorded at two sites (mesial and distal) on each tooth, lingually on

lower teeth and buccally on upper teeth. The numbers of teeth with PD≥4mm and LOA≥4mm were the outcome measures for analysis.

Statistical analysis

All analyses were weighted to account for the survey design and possible non-response bias (Kelly et al., 2000). We first compared the socio-demographic composition of the study sample with the eligible sample of dentate adults who participated in the interviews using the Chi-squared test. We also compared the socio-demographic composition of the four long-term patterns of dental attendance using the Chi-squared test.

The association between long-term dental attendance pattern and the number of teeth with PD≥4mm was first assessed in crude models using negative binomial regression as the latter measure was a count variable with over-dispersion. Rate ratios (RR) were thus reported. The above association was then sequentially adjusted for demographic factors (sex, age and country of residence) and socioeconomic factors (education and social class). The moderating role of sex, age, education and social class on the association between long-term patterns of dental attendance and the number of teeth with PD≥4mm was examined by testing the significance of the statistical interaction (cross-product) between each of the above factors and long-term dental attendance pattern in a model also including the main effects. The same modelling strategy was followed for the number of teeth with LOA≥4mm.

Results

The study sample included 3272 dentate adults aged 16 years and over. No major differences in socio-demographic composition were found between the study sample and the eligible sample of dentate adults who participated in interviews (Table 1). Overall, 32%, 31%, 27% and 9% of participants were classified as current, former, always and never regular attenders, respectively. The mean number of teeth with PD≥4mm was 3.1 (SD: 3.6; range: 0-30) and the mean number of teeth with LOA≥4mm was 2.5 (SD: 3.3; range: 0-28).

There were significant differences in the socio-demographic composition of the four dental attendance groups. The group of always regular attenders had more women than the other three groups. Former and always regular attenders were younger than current and never regular attenders. The group of never regular attenders included fewer people from England than the other three groups. In addition, they were less educated and from lower social class (Table 2).

Current, former and never regular attenders had more teeth with PD≥4mm than always regular attenders (3.1, 3.3 and 4.4 versus 2.6). The mean number of teeth with PD≥4mm was, respectively, 1.58 (95% Confidence Interval: 1.28-1.95) and 1.34 (95% CI: 1.12-1.60) times greater in never and former regular attenders compared to always regular attenders, after adjusting for sex, age, country of residence, education level and social class. However, differences between always and current regular attenders were no longer significant (Table 3). The two-way interaction terms of long-term dental attendance pattern with sex, age, education and social class, respectively, were not significant (all $p>0.05$).

Similar results were found for the number of teeth with LOA≥4mm (Table 4). Current and never, but not former, regular attenders had more teeth with LOA≥4mm than always regular attenders (2.5, 3.6 and 2.5 versus 2.2). In addition, the mean number of teeth with LOA≥4mm was 1.34 (95% CI: 1.04-1.72) and 1.37 (95% CI: 1.07-1.75) times greater in never and former than in always regular attenders after adjusting for socio-demographic characteristics. However, no difference was found between current and always regular attenders. None of the four two-way interactions were significant (all $p>0.05$).

Discussion

This study shows that never and former regular attenders had worse periodontal status than always regular attenders. On the other hand, we found no evidence of differences in periodontal conditions between current and always regular attenders.

Some limitations of this study need to be borne in mind when interpreting the present results. First, we used data from a relatively old survey despite data from the latest national survey, carried out in 2009, were already available. This was because the items needed to estimate trajectories of dental attendance were dropped from the questionnaire used in 2009. Although some may question whether our findings are still relevant today due to recent improvements in dental attendance (Hill et al., 2013, Nuttall et al., 2001) and periodontal disease (White et al., 2012, Morris et al., 2001), the role of behaviours in explaining health variations has not changed since those associations were first identified (e.g. sugars intake remains related to dental caries and smoking to periodontal disease despite changes over time). That said, the present findings await corroboration from studies using contemporaneous data. Second, the fact that our study sample represented 62% of the adults with some natural teeth who participated in the 1998 Adult Dental Health Survey may raise some concerns about its representativeness. However, we found no socio-demographic differences between our study

sample and the eligible sample of dentate adults. Moreover, data weighting was used to correct for differences in the probability of selection as a result of non-response, to adjust for key demographic differences between the sample and the entire population and to allow the generalisation of findings to the whole population, not just those who responded to the survey. Third, information on dental attendance patterns relied on self-reports, which may be less reliable than data extracted from clinical records. Although high levels of agreement have been found between self-reported dental visits and data from dental records (Gilbert et al., 2002, Gilbert et al., 2003), evidence comes from the US which may not be directly applicable to the UK context. However, data from clinical records is rarely available for research purposes which may be the reason why all previous longitudinal studies used self-reported dental attendance (Thomson et al., 2010, Crocombe et al., 2012, Astrom et al., 2014, Brennan and Spencer, 2014). As dental attendance pattern is probably under-recorded when using self-reports, the estimates of the association between dental attendance and periodontal disease may be somewhat conservative in this study. Fourth, we used retrospective data collected at a single point in time to derive long-term patterns of dental attendance, which could be subject to measurement bias, potentially greater measurement error and underestimation of associations with periodontal disease.

This study has two main findings. On one hand, never and former regular attenders had greater levels of periodontal disease than always regular attenders. The magnitude of the differences between the two extreme groups was such that never regular attenders had 58% more teeth with PD$\geq$4mm and 34% more teeth with LOA$\geq$4mm than always regular attenders when surveyed in 1998. Never regular attenders may miss the benefits of having regular check-ups, such as having the opportunity to arrest disease development through preventive advice, improved oral hygiene and appropriate treatment initiation (Davenport et al., 2003, Riley et al., 2013). On the other hand, we found no differences in levels of periodontal disease between always and current regular attenders, a finding that resembles previous reports on caries experience in the UK (Aldossary et al., 2015) and total tooth loss in Sweden (Astrom et al., 2014). These findings support the view that more proximal exposure to regular dental attendance is beneficial to adult oral health (Thomson et al., 2010) and may even wipe out earlier negative experiences. This finding is in line with previous life course studies in the UK where current socioeconomic circumstances were more relevant to adult oral health than early life circumstances (Delgado-Angulo and Bernabe, 2015a, Delgado-Angulo and Bernabe, 2015b).

Some authors have argued that differences between trajectories of dental attendance could be due to the healthy user effect (Astrom et al., 2014, Thomson et al., 2010); that is, the propensity of individuals who receive one preventive measure to also seek other preventive services or partake in other healthy behaviours (Shrank et al., 2011). As a result, an observational study evaluating the effect of a preventive measure on a related outcome without adjusting for other related preventive behaviours will tend to overstate the effect of the preventive measure under study (Brookhart et al., 2007). Confounding by the healthy user effect is ubiquitous in observational studies and often a better or alternate explanation for unanticipated benefits (Shrank et al., 2011, Brookhart et al., 2007). Since data on important risk factors of periodontal disease (smoking and diabetes) were not collected in the 1998 survey, we attempted to minimise the healthy user effect by controlling for participants' demographic and socioeconomic background because healthier subjects tend to be female, younger, more educated and wealthier than their counterparts. Although not ideal, using multiple socioeconomic indicators in the regression models allowed controlling, at least partially, for the influence of smoking and diabetes on the results since the latter factors are socially patterned (Watt and Petersen, 2012, Thomson et al., 2012). Future studies are encouraged to evaluate the specific roles of chronic conditions and preventive behaviours on the association between dental attendance pattern and periodontal disease.

In conclusion, this analysis of national cross-sectional data showed that different dental attendance patterns during the life course are associated with different periodontal health status. Never and former regular attenders had greater levels of periodontal disease than always regular attenders. However, there were no differences in periodontal status between always and current regular attenders.

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Table 1. Characteristics of the study sample and comparison with eligible dentate adults

Explanatory variables	All dentate (n=5281)		Study sample (n=3272)	
	n[a]	%	n[a]	%
Sex				
Men	2406	50	1555	53
Women	2875	50	1717	47
Age group				
16-24 years	680	16	406	15
25-34 years	1103	23	776	24
35-44 years	1032	20	684	21
45-54 years	989	18	648	18
55-64 years	664	11	387	11
65-74 years	520	8	267	8
75 years and over	293	4	104	3
Country of residence				
England	3010	84	1903	84
Wales	682	5	432	5
Scotland	953	8	563	8
Northern Ireland	636	3	374	3
Educational attainment				
No qualifications	1286	22	659	20
Below degree level	3087	62	2048	63
Degree level or above	756	16	565	17
Social class				
I/II (Highest)	1770	39	1306	39
IIIM/IIINM	2071	43	1391	43
IV/V (Lowest)	926	18	575	18

[a] Counts are unweighted

Table 2. Socio-demographic characteristics of adults with different long-term patterns of dental attendance (n=3272)

Explanatory variables	Always regular (n=964)		Current regular (n=1075)		Former regular (n=925)		Never regular (n=308)		p value[b]
	n[a]	%	n[a]	%	n[a]	%	n[a]	%	
Sex									<0.001
Men	301	35	545	55	524	63	185	62	
Women	663	65	530	45	401	37	123	38	
Age groups									<0.001
16-24 years	148	20	46	6	190	23	22	9	
25-34 years	188	18	238	22	290	32	60	18	
35-44 years	205	20	241	23	177	19	61	20	
45-54 years	195	19	256	21	154	15	43	14	
55-64 years	116	11	155	14	65	6	51	18	
65-74 years	85	8	99	9	34	4	49	15	
75 years and over	27	4	40	4	15	1	22	8	
Country of residence									0.001
England	553	85	662	86	530	84	158	81	
Wales	152	6	136	4	105	4	39	5	
Scotland	152	7	180	8	173	9	58	9	
Northern Ireland	107	2	97	2	117	3	53	4	
Education level									<0.001
No qualifications	146	15	221	20	159	17	133	42	
Below degree level	633	67	637	61	625	67	153	50	
Degree level or above	185	18	217	19	141	16	22	8	
Social class									<0.001
I/II (Highest)	448	45	469	44	309	34	80	24	
IIIM/IIINM	378	39	441	42	428	46	144	45	
IV/V (Lowest)	138	16	165	15	188	20	84	30	

[a] Counts are unweighted
[b] The Chi-square test was used for comparison

Table 3. Regression models for the association between long-term patterns of dental attendance and number of teeth with PD≥4mm (n=3272)

Explanatory variables	Model 1A[a]		Model 1B		Model 1C	
	RR[b]	**[95% CI]**	**RR**	**[95% CI]**	**RR**	**[95% CI]**
Dental attendance pattern						
Always regular	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Current regular	1.20	[1.02-1.41]*	1.05	[0.89-1.24]	1.05	[0.89-1.24]
Former regular	1.23	[1.04-1.46]*	1.38	[1.16-1.65]***	1.34	[1.12-1.60]**
Never regular	2.03	[1.65-2.51]***	1.71	[1.39-2.11]***	1.58	[1.28-1.95]***
Sex						
Men	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Women	0.87	[0.76-0.98]*	0.86	[0.76-0.98]*	0.85	[0.75-0.97]*
Age group						
16-24 years	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
25-34 years	1.99	[1.51-2.62]***	1.93	[1.48-2.54]***	1.95	[1.49-2.57]***
35-44 years	2.53	[1.94-3.29]***	2.54	[1.94-3.32]***	2.55	[1.94-3.34]***
45-54 years	2.92	[2.25-3.78]***	3.00	[2.31-3.90]***	3.07	[2.35-4.02]***
55-64 years	3.44	[2.58-4.58]***	3.46	[2.59-4.62]***	3.39	[2.53-4.55]***
65-74 years	4.54	[3.43-6.02]***	4.69	[3.51-6.27]***	4.63	[3.42-6.26]***
75 years and over	5.45	[3.80-7.82]***	5.76	[3.95-8.40]***	5.65	[3.82-8.34]***
Country						
England	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Wales	0.73	[0.62-0.86]***	0.71	[0.61-0.84]***	0.73	[0.62-0.86]***
Scotland	0.84	[0.72-0.98]*	0.89	[0.76-1.04]	0.88	[0.76-1.03]
Northern Ireland	0.62	[0.50-0.76]***	0.69	[0.54-0.87]**	0.67	[0.53-0.85]**
Education level						
No qualifications	1.00	[Reference]			1.00	[Reference]
Below degree level	0.64	[0.55-0.74]***			0.92	[0.79-1.08]
Degree level or above	0.54	[0.45-0.66]***			0.79	[0.63-0.99]*
Social class						
I/II (Highest)	1.00	[Reference]			1.00	[Reference]
IIIM/IIINM	1.22	[1.07-1.40]**			1.09	[0.94-1.26]
IV/V (Lowest)	1.36	[1.15-1.61]***			1.26	[1.04-1.53]*

[a] Model 1A was unadjusted; Model 1B adjusted for sex, age groups and country of residence; and Model 1C also adjusted for education level and social class.
[b] Negative binomial regression was used and rate ratios (RR) reported.

Table 4. Regression models for the association between long-term pattern of dental attendance and number of teeth with LOA≥4mm (n=3272)

Explanatory variables	Model 2A		Model 2B		Model 2C	
	RR[a]	**[95% CI]**	**RR[a]**	**[95% CI]**	**RR[a]**	**[95% CI]**
Dental attendance pattern						
Always regular	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Current regular	1.23	[1.02-1.49]*	0.96	[0.79-1.16]	0.95	[0.79-1.16]
Former regular	1.01	[0.82-1.25]	1.47	[1.15-1.88]**	1.37	[1.07-1.75]*
Never regular	2.28	[1.81-2.89]***	1.52	[1.19-1.94]**	1.34	[1.04-1.72]*
Sex						
Men	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Women	0.81	[0.70-0.94]**	0.81	[0.69-0.96]*	0.80	[0.68-0.94]**
Age group						
16-24 years	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
25-34 years	2.52	[1.62-3.92]***	2.47	[1.62-3.78]***	2.44	[1.60-3.74]***
35-44 years	3.98	[2.64-5.99]***	4.39	[2.95-6.54]***	4.32	[2.89-6.47]***
45-54 years	7.16	[4.79-10.72]***	7.72	[5.22-11.42]***	7.69	[5.16-11.46]***
55-64 years	12.04	[8.06-17.99]***	13.08	[8.87-19.29]***	12.38	[8.30-18.47]***
65-74 years	15.33	[10.31-22.81]***	17.54	[11.87-25.91]***	15.79	[10.50-23.75]***
75 years and over	22.14	[14.63-33.50]***	25.62	[16.90-38.84]***	23.62	[15.22-36.64]***
Country						
England	1.00	[Reference]	1.00	[Reference]	1.00	[Reference]
Wales	0.75	[0.60-0.94]*	0.60	[0.49-0.73]***	0.61	[0.50-0.74]***
Scotland	1.05	[0.89-1.24]	1.13	[0.93-1.38]	1.14	[0.94-1.37]
Northern Ireland	0.68	[0.54-0.86]**	0.81	[0.62-1.07]	0.77	[0.59-1.01]
Education level						
No qualifications	1.00	[Reference]			1.00	[Reference]
Below degree level	0.45	[0.38-0.52]***			0.79	[0.63-0.99]*
Degree level or above	0.35	[0.28-0.45]***			0.55	[0.40-0.75]***
Social class						
I/II (Highest)	1.00	[Reference]			1.00	[Reference]
IIIM/IIINM	1.25	[1.05-1.47]*			1.09	[0.89-1.32]
IV/V (Lowest)	1.45	[1.18-1.78]***			1.15	[0.91-1.47]

[a] Model 2A was unadjusted; Model 2B adjusted for sex, age groups and country of residence; and Model 2C also adjusted for education level and social class.
[b] Negative binomial regression was used and rate ratios (RR) reported.